New research shows slight of hand is not so slight

April 17 2008

Typing on a keyboard or scribbling on paper may be similar activities, but there is a significant difference in how the body moves, according to new motor development research.

"In language we start with letters that lead to syllables that lead to words, and we use grammar to put everything together," said Howard N. Zelaznik, a Purdue University professor of health and kinesiology. "One of the fundamental questions in motor control is whether there is an alphabet that guides movement.

"We wanted to know if discrete skills, which have a definite beginning and end, such as typing, are controlled identically to continuous skills, such as scribbling, which do not have such a clear beginning and end. Or, are continuous movements composed of a series of discrete movements that are knotted together" On both accounts, the answer is no."

Zelaznik was part of research team led by Viktor Jirsa, director of research at the Centre National de la Recherche Scientifique (CNRS) and a professor of movement sciences at the University of the Mediterranean in Marseilles, France, and Raoul Huys, a research associate at the Centre National de la Recherche Scientifique as well as at the University of the Mediterranean. Purdue graduate students Breanna Studenka and Nicole Rheaume also were part of the team. Their research findings were published Thursday (April 17) in the Public Library of Science's *Computational Biology* online journal.

"Potential implications for physical therapy and humanoid robotics are immense," Zelaznik said. "This work shows that discrete and continuous movements must be considered separate classes of movement."

For example, in a physical therapy setting many skills are taught discretely first, such as stepping or bending a joint, and then the patient is told to perform continuously, such as walking. Humanoid robots, which resemble people and walk upright, often control movements as a series of discrete actions.

"Prior to this work, the basis for explaining the relationship of these skill sets was based upon inferences from empirical movement data," Zelaznik said. "In our research, we mathematically and computationally demonstrate that the discrete model cannot be morphed into a continuous model and vice versa. Discrete models cannot produce fast repetitive movements, which shows us there is a difference in how the brain controls the body's slightest action."

These models are based on the assessment of eight study participants who performed timed finger-tapping tasks to match the tempo produced by a metronome. There were three conditions: moving as fast as possible, moving as smoothly as possible or moving naturally with no instruction. While the speed was manipulated, the participants' movement trajectories were recorded.

Zelaznik said the research team next may look at how these findings apply to other parts of the body, as well as evaluate more sophisticated tasks such as playing a musical instrument or throwing a baseball.

Zelaznik's component of this research was funded by the National Science Foundation. He also is collaborating with Purdue engineering professor C.S. George Lee and researchers from the Advanced Institute of Science and Technology in Japan to help create humanoid robots that

move more like people.

Source: Purdue University